EXACT

ELECTRONICS, INC.

BAC 523499

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INSTRUCTION MANUAL

TYPE 250

S/N [redacted]

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Issue # 2

INSTRUCTION MANUAL

TYPE 250
S/N [redacted]

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IF YOUR INSTRUMENT DOES NOT OPERATE

PLEASE

1. Check operating procedure in manual for proper set-up.

2. Check fuse and power supply voltages.

3. Consult the brief trouble shooting guide at the beginning of the MAINTENANCE section of this manual.

4. Call your EXACT representative or the factory collect.

A new instrument should operate properly on arrival and no-one wishes this more than Exact. Many things keep this from happening in every case and if yours is the exception, you should be inconvenienced as little as possible. Some people like to find a trouble themselves, others prefer not to touch an instrument without representation from the manufacturer. **YOUR WARRANTY WILL IN NO WAY BE AFFECTED BY YOUR EFFORT TO FIND THE TROUBLE AND PUT YOUR INSTRUMENT IN EARLY OPERATION.** We leave it to your judgment and offer the services of our representatives and our factory to give you the assistance you need.

All Exact instruments are fully guaranteed against defective materials and workmanship for one year. Replacement parts requests should be clearly identified and the instrument serial number given. The needed parts will be air shipped to you within 24 hours.

Exact Electronics, Inc., was founded in July of 1957 for the purpose of supplying the needs of research, industry and government for precision calibration and waveform generating test equipment. We have dedicated ourselves to the continuing search for what is most needed in these fields and the best way to engineer and produce it.

A good deal of consideration was given before selecting the type of firm and kind of people we wanted to complete the communication between yourself and us. We're proud to suggest the following people as the ones for you to contact regarding application, purchasing or servicing of Exact instruments:

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PHILADELPHIA (Metro) N. JERSEY	C. E. SNOW CO., 613 Cheltenham Ave., Philadelphia, Penn.	CA 4-2626
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WASHINGTON, D. C.	C. E. SNOW CO., 8218 Wisconsin Ave., Bethesda, Maryland	OL 4-1767
VIRGINIA	C. E. SNOW CO., 801 Hamilton St, Richmond, Virginia	353-8008
WEST PENNSYLVANIA	THE SATULLO CO., P. O. Box 65, Bakerstown, Pennsylvania	HI 3-6110

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S. OHIO	THE SATULLO CO., 785 W. Ohio Pike, Cincinnati 45, Ohio	752-6683
MICHIGAN	THE SATULLO CO., 4514 No. Woodward, Royal Oak, Michigan	JO 6-2375
CHICAGO (Metro) ILL., IND., IOWA, WISC.	BARD ASSOCIATES INC., 328 Selbourne Road, Riverside, Illinois	HI 7-7555
TWIN CITIES	NORTHPORT ENGINEERING INC., 1729 Selby Avenue, St. Paul, Minnesota	MI 6-2621
TEXAS-OKLAHOMA	DATRONICS INC., 1401 S. Post Oak Rd., Houston 27, Texas	SU 2-0432

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NORTHWEST	COMPTRONICS, No. 2 Hanford St., Seattle, Washington	MA 4-5135

OVERSEAS

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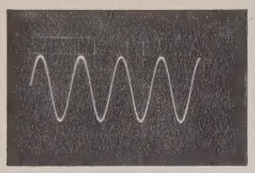
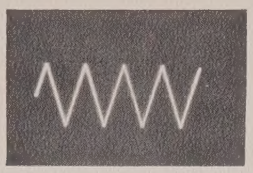
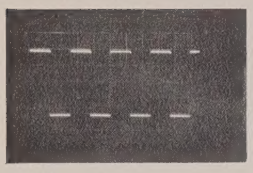
BELGIUM	REGULATION-MESURE SPRL, 22 Rue Saint-Hubert, Bruxelles 15, Belgium
FRANCE	RELATIONS TECHNIQUES INTERCONTINENTALES, 134 Avenue de Malakoff, Paris 16, France MAURICE I. PARISIER & CO., 741-745 Washington St., New York 14, New York
GERMANY (WEST)	ROHDE & SCHWARZ VERTRIEBS GMBH, Hohe Strasse, 160-168, Koln, West Germany
GREECE	MARIOS DALLEGGIO REPRESENTATIONS, 2 Alopekis St., Athens K., Greece
ISRAEL	LANDSEAS (ISRAEL) LTD., 13 Idelson St., Tel Aviv, Israel LANDSEAS CORPORATION, 48 West 48th St., New York 36, New York
ITALY	SILVERSTAR LTD., 21 via Visconti di Modrone, Milano, Italy
JAPAN	MIDORIYA ELECTRIC CO. LTD., 3, 2-Chome, Kyobashi, Chuo-Ku, Tokyo, Japan
THE NETHERLANDS	C. N. ROOD NV, 11-13 Cort van der Lindenstraat, Rijswijk, Z. H., The Netherlands
SWEDEN	ERIK FERNER AB, Snormakarvagen 35, Box 56, Bromma, Sweden
SWITZERLAND	OMNI RAY AG, Dufourstrasse 56, Zurich 8, Switzerland

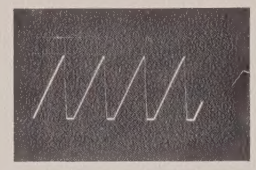
SINE – SQUARE – RAMP – TRIANGLE

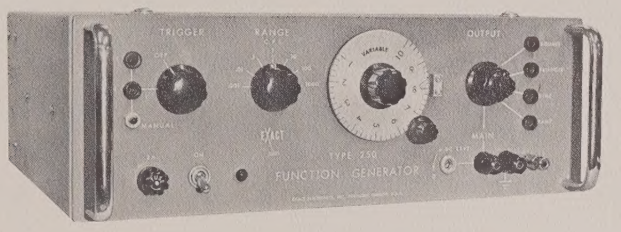






ELECTRO-MECHANICAL STUDIES
MULTIPLE WAVEFORM SOURCE
GEOPHYSICAL SIMULATION
ANALOG COMPUTER WORK
MEDICAL STIMULATION
QC AND CALIBRATION
SWEEP GENERATION





TYPE 250 SPECIFICATIONS

	MAIN OUTPUT	AUXILIARY OUTPUTS
Amplitude	5 to 25 Volts	25 Volts
Amplitude Stability	Within 1%	Within 1%
Amp. Change with Freq.	½% from .001 to 1KC — 2% from 1KC to 10KC	
DC Reference (Center)	—13 to +13 Volts (Variable)	Approx. +13V (Fixed)
DC Reference Stability	Within 1%	Within 1%
Output Impedance	Cathode Follower (Var.)	Cathode Follower
Output Current	15MA Above Ground to 3MA Below Ground	5MA
Waveform Starts	Center Reference — Sine & Triangle Base Line — Square & Ramp	

TRIGGERING

Internal Free Running
External (10V Signal)
Manual Push Button

TIMING

Range ..... .001 to 10KC Continuous Var.
Dial Accuracy ..... Better Than 97%
Stability (Long Term) ..... Better Than 98%

GENERAL

Size: Cabinet ..... 5¼ x 15¼ x 15
Rackmount ..... 5¼ x 19 x 15

Weight ..... 17 Pounds

Power ..... 175 Watts
110/250 Volts 50-60 Cycles

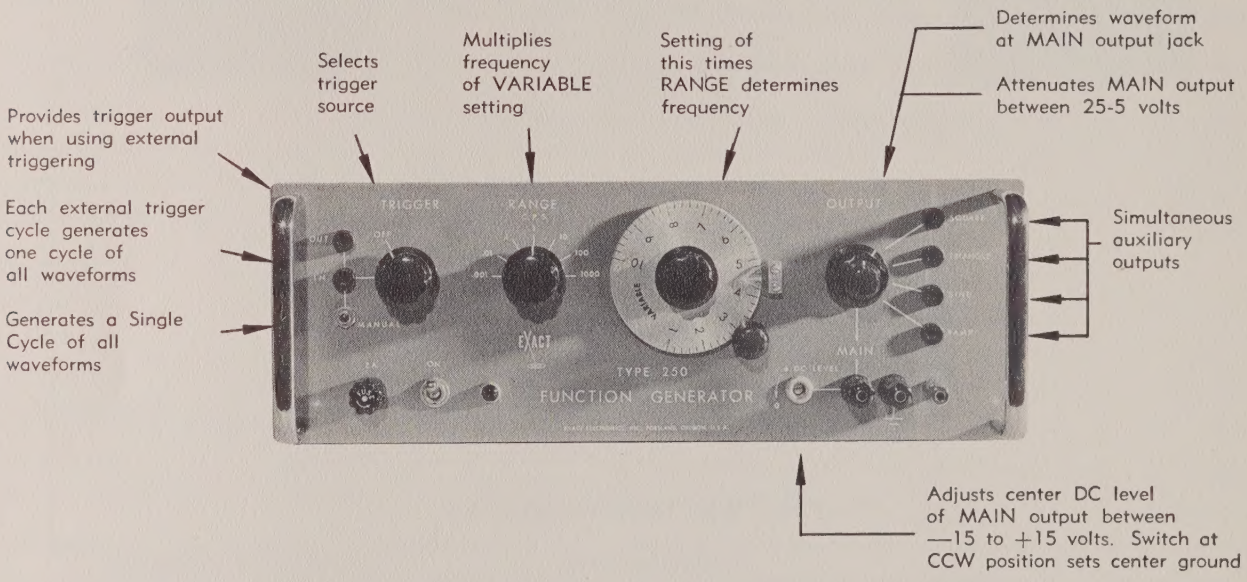
PRICE: $550.00 FOB Factory
All Accessories Included

EXACT

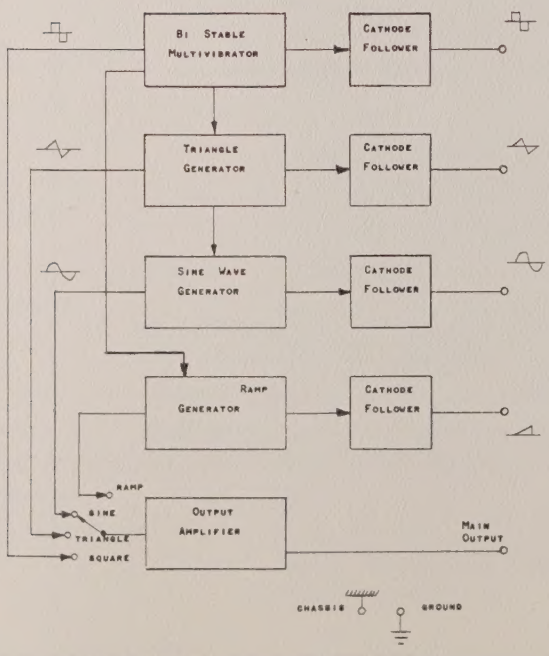
EXACT ELECTRONICS, INC.
455 S. 2nd Ave. - P.O. Box 160 - HILLSBORO, OREGON
Phone: Midway 8-3590 Area Code: 503

The Exact type 250 generates five separate simultaneous outputs. A SINE, SQUARE, TRIANGLE and RAMP waveform are each available from auxiliary jacks at 25V and 5MA. The MAIN output has available any one of the 4 functions depending on the setting of the OUTPUT switch. The center DC reference of the MAIN output may be varied from -15 to +15V or switched to ground. Available power is 25V (variable) at 15 MA.

The frequencies of all waveforms may be continuously varied from 0.001 cycles per second to 1.0KC. In addition to repetitive operation all of the waveforms may be manually triggered or powered from an external source. All waveforms are at the same amplitude and this amplitude is constant over the entire frequency range.


Selects trigger source
Multiplies frequency of VARIABLE setting
Setting of this times RANGE determines frequency
Determines waveform at MAIN output jack
Attenuates MAIN output between 25-5 volts
Provides trigger output when using external triggering
Each external trigger cycle generates one cycle of all waveforms
Generates a Single Cycle of all waveforms
Simultaneous auxiliary outputs
TRIGGER
RANGE
OUTPUT
VARIABLE
MANUAL
EXACT
MAIN
TYPE 250
FUNCTION GENERATOR
Adjusts center DC level of MAIN output between —15 to +15 volts. Switch at CCW position sets center ground

BLOCK DIAGRAM



OUTPUT VOLTAGES

RISETIME..... 5 μsec
SYMMETRY.....99%
OVERSHOOT.....1%

25V

LINEARITY.....99.5%
SYMMETRY.....99%

25V

DISTORTION
LESS THAN.....2%

25V

LINEARITY.....99.5%

25V

MAIN OUTPUT

25V or 25V or 25V or 25V

1-3 OPERATION

1-31 The general purpose of the Type 250 is to generate square, sine, triangle and ramp waves over a continuously variable frequency range of 0.001 cycles per second to 10 KC. These waveforms are available simultaneously from the designated jacks on the right hand side of the front panel or singly as selected from the main output jack. The waveforms may be continuous, externally triggered or triggered by the Manual push button.

1-32 For first time operation, follow this procedure:

*BE SURE UNIT HAS GOOD VENTILATION. DO NOT STACK BOOKS OR PAPERS ON TOP OF CABINET.

A. Turn power switch ON.

B. Set the OUTPUT switch to TRIANGLE.

C. Turn the OUTPUT ATTEN. (red concentric knob) fully CW.

D. Turn the DC LEVEL screwdriver adj. all the way CCW until you are in the switched position.

E. Set the CYCLES/SECOND dial to 5.

F. Set the TIME MULTIPLIER to 100.

G. Set the TRIGGER switch to INT (off).

H. Connect the MAIN OUTPUT to a monitor scope.

I. Be sure that the CHASSIS ground post and the CABINET ground post are shorted together.

J. Connect the TRIGGER OUT jack to the external trigger input of the monitor scope.

K. Set the monitor scope controls for:

External triggering
2 msec/cm time base
DC coupled input
5 volts/cm vertical deflection

1-33 You should be observing about 10 cycles of triangle waveform on the monitor scope. Try the following adjustments to become better acquainted with the front panel controls:

A. Switch the OUTPUT switch to each of the 4 waveforms and notice the stability of amplitude and DC level.

B. Turn the OUTPUT ATTEN. CCW (you should attenuate from 30 to approx. 5 volts).

C. Connect your main output lead from the scope to each of the four separate SQUARE, TRIANGLE, SINE AND RAMP waveforms. These amplitudes are fixed at 30 volts and their center DC reference levels are fixed at 0. (internal adjustments can change this level if desired).

D. Again observe the MAIN OUTPUT with the monitor scope and turn the ±DC LEVEL screwdriver adjust CW through its full range. The waveform should move from entirely below ground to entirely above ground.

E. Vary the CYCLES/SECOND and the TIME MULTIPLIER and observe the amplitude and DC level stability.

F. Turn the TRIGGER OUT switch to EXT (in) and apply a 10 volt trigger signal with better than a 10 usec rise-time. Also press the MANUAL trigger button. You will notice that the waveforms trigger at the following levels:

Square ---------- most negative
Sine ---------- center
Triangle --------- center
Ramp ---------- most negative

You now have your "PILOT'S LICENSE" and we hope you will enjoy the use of your FUNCTION GENERATOR. Should you have any trouble or want to do something special with the unit (everyone does), please call your local representative listed at the front of this manual or phone us collect.

1-4 TROUBLE TIPS

FUSE BLOWING ----------	Shorted rectifier diodes.
EXCESSIVE HUM, DRIFT OR JITTER ------	Power supplies out of regulation. Ground strap between chassis ground and circuit ground missing on front panel.
NO OUTPUT OR IMPROPER DC LEVEL OUT ---------	Trigger source in EXT position. Check ±DC LEVEL pot/switch.
TIMING OFF DISTORTED TRIANGLE----	Bad V4 or V5. Triangle adjustments off.
RAMP INOPERATIVE OR SKIPPING ----------	Bad V10. Ramp length/level adjustments off.
SQUARE WAVE UNSYMMETRICAL --------	Square symmetry (2) adjustments off.
DISTORTED SINE WAVE ----	Bad V7. Sine adjustments off (all square & triangle adjustments will effect).
MANUAL OR EXTERNAL TRIGGERING INOPERATIVE OR UNIT STILL RUNS CONTINUOUSLY IN EXT POSITION ----------	Bad V3.

1-5 APPLICATIONS

General waveform source for research, analog computers, systems checking.

Check out of recorders (Ramp - Triangle).

Source of sweep voltages for monitor scopes, recorders, etc. (Ramp).

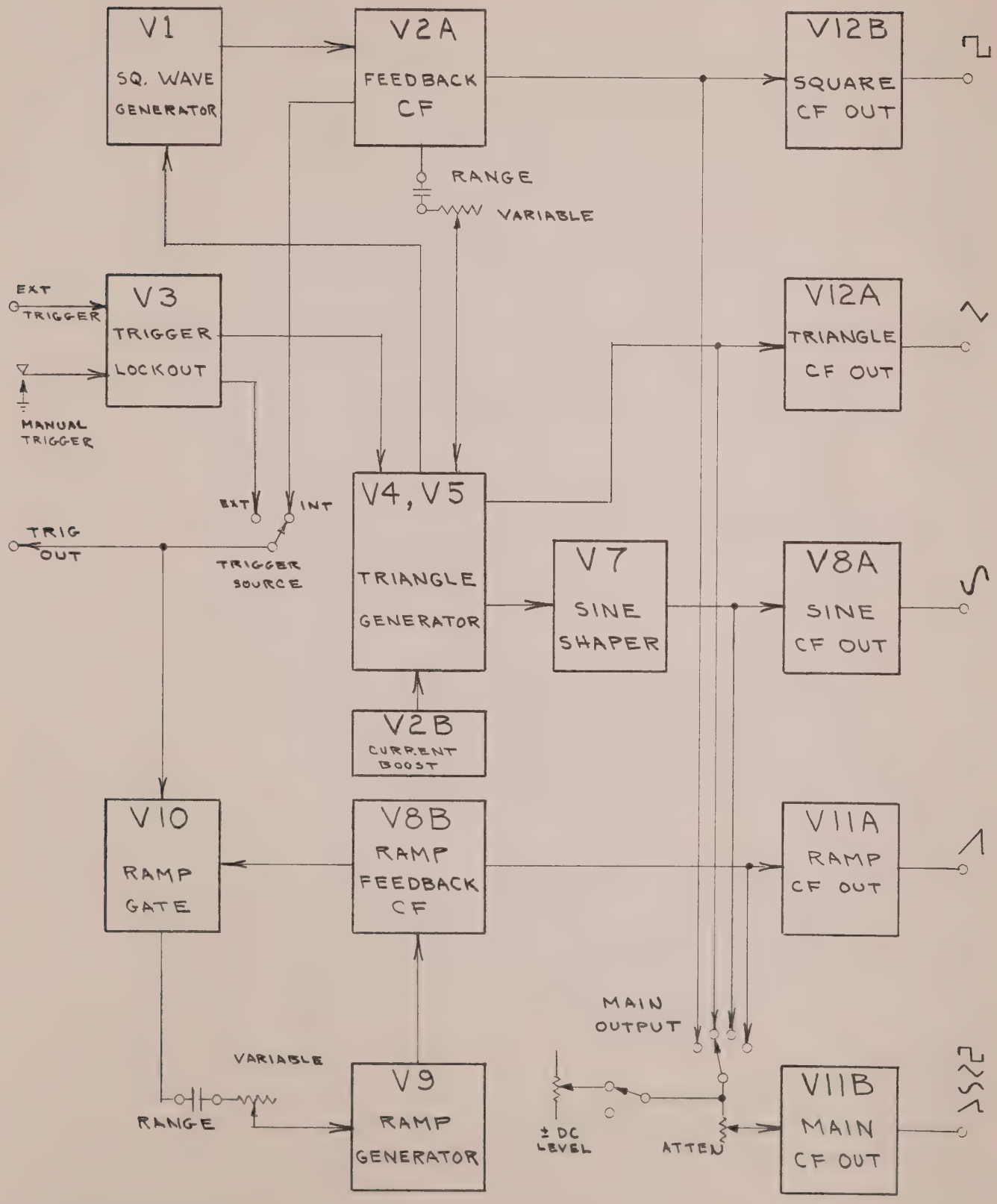
Low frequency square wave response check.

Triangle as raster generator.

Linearity checking of instruments or systems by varying DC level amplitude or frequency while holding one or both of the other parameters constant.

Delay trigger generator (trigger Type 250 externally and use square or ramp fall, which is variable over entire timing range) to trigger scope or other equipment.

TYPE 250 BLOCK DIAGRAM



2-2 TROUBLE SHOOTING PROCEDURE

2-21 POWER SUPPLY

All circuits depend on the regulated -210v, +95v & +250v. The more critical generating circuits also depend on the -11v filament regulation. Always check these supplies for proper voltage and below 10mv of ripple. (500mv on -11v supply.)

-210v problems check V103; V102; V101; -210 ADJ R23; Diodes D9-D12.

+95v problems check -210v; V104; V103; divider voltage pin 1, V104; diodes D5-D8.

+250v problems check -210v; V106; V105; divider voltage pin 1, V106; diodes D1-D4.

-11v problems check Q1; ZENER, D17; diode D18, diodes D13-D16.

2-22 SQUARE WAVE

V1 generates the square wave and also gates the triangle miller integrators V4 & V5. Problems involving square wave only should be traced to V12B, V2A and V1 in that order.

2-23 TRIANGLE

V4 & V5 are differential miller integrators and produce a positive and negative going voltage which is fed back to each half of V1 to determine the flipping time of the multivibrator. V2B merely furnishes a constant current source for the integrators. Problems involving triangle only should be traced to V12A, V4, V5, V2B, R166 & R157 settings in that order.

2-24 SINE

V7 shapes the triangle and depends on accurate symmetry of the square wave and triangle as well as proper input level of triangle. All previous settings and calibration procedures should be checked before further trouble shooting the sine wave. After doing this, trace problem to V8A, V7, SINE SHAPE adjustments (R171, R172, R173) and SINE DC LEVEL R182 in that order.

2-25 RAMP

V10 is triggered by V1 (internal triggering) or V3 (external triggering) and furnishes the gate for miller integrator V9. Problems involving ramp only should be traced to V11A, V9, V8B, V10, RAMP LEVEL & RAMP LENGTH (R209 & R211) settings, D108 & D109 in that order.

2-26 MULTIPLE TROUBLES

Diodes D105 and D106 could cause all waveforms to be out.

Square Wave Symmetry adjustments would cause malfunction of triangle and sine.

Switch contact problems could cause assorted malfunctions.

External trigger tube V3, holdoff level R136 and diode D104 could all cause lack of or improper external triggering.

Lack of main output could be V11B or the switch pot ± DC OUTPUT LEVEL.

2-3 CIRCUIT DESCRIPTION

2-31 POWER SUPPLY

The three power supplies are all based on the same principle; a DC amplifier is referenced to a standard voltage (a 5651 gas tube or precision dividers from -210V). Any variation from line or load is amplified by the DC amplifier and passed along as a control voltage to the series regulator tube. The filament supply is regulated by a transistor referenced to a zener diode.

2-32 SQUARE WAVE GENERATOR

V1 A&B are a bi-stable multivibrator with an electron coupled output from pin #6. This output swings from below -100V, when V1B is conducting, to +100V when it is cut off. The time duration of each half-cycle is determined by the triangle waveform at grid pins #2 and #9. The negative halves of the triangle from V4A&B are coupled back through diodes D105 and D106 to grid pins #2 and #9 of V1A and B cutting off the conducting half of the multivibrator. This determines the timing of the instrument.

V2A IS A CATHODE FOLLOWER WHOSE OUTPUT HAS FOUR PARTS.

A) SQUARE WAVE SYMMETRY (X10), R122 PROVIDES FOR EQUAL VOLTAGE BUT OPPOSITE POLARITY AT X10 END OF VARIABLE (CPS) DIAL FOR EACH HALF-CYCLE OF V1.

B) PROVIDES STANDARD SQUARE WAVE TO OUTPUT CATHODE FOLLOWER V12B.

C) PROVIDES SQUARE WAVE TO MILLER INTEGRATOR TIMING RESISTORS AND CAPACITORS (R132-R135 AND C102A-F).

D) PROVIDES SQUARE WAVE TO RAMP GATE V10 AND "TURN-OFF" VOLTAGE TO EXTERNAL TRIGGER MULTIVIBRATOR, V3.

2-33 TRIANGLE GENERATOR

V4A, V4B, V5A AND V5B ARE PUSH-PULL MILLER INTEGRATION AMPLIFIERS WITH THEIR ASSOCIATED CATHODE FOLLOWERS. THE SYMMETRICAL SQUARE WAVE FROM V2A IS FED TO GRID PIN #2 OF V4A AND THE INTEGRATOR ACTION PRODUCES A TRIANGLE WAVEFORM AT THE CATHODE FOLLOWER CATHODES (PINS #8 OF V4B AND V5B). TIME CONSTANTS FOR THE INTEGRATOR ARE C102 (A-F), R124A AND R132-R135. BOTTOM TRIANGLE (R106) AND TOP TRIANGLE (R157) DETERMINE THE VOLTAGE LEVEL FED BACK TO THE GRIDS OF V1 AND THUS THE MAIN TIMING OF THE UNIT. V2B IS A CONSTANT CURRENT SOURCE FOR THE INTEGRATOR AMPLIFIERS TO INCREASE THEIR STABILITY AND OPERATING CHARACTERISTICS.

2-34 SINE WAVE GENERATOR

V7 IS A PENTODE WHOSE BIAS CHARACTERISTICS ARE ADJUSTED BY THREE SINE SHAPING ADJUSTMENTS, R171, R172 AND R173. THE LINEAR TRIANGLE FROM V4B IS SHAPED BY THESE ADJUSTMENTS TO PRODUCE A VERY LOW DISTORTION SINE WAVE AT THE PLATE PIN #5.

SINE ADJ A CONTROLS THE DC LEVEL OF THE GRID.

SINE ADJ B CONTROLS THE AMPLITUDE OF THE TRIANGLE INTO GRID PIN #1 OF V7.

SINE ADJ C CONTROLS THE SUPPRESSOR BIAS OF V7.

2-35 RAMP GENERATOR

V10 IS A CATHODE COUPLED MULTIVIBRATOR WHICH SHAPES THE RELATIVELY SLOW RISE SQUARE WAVE INPUT TO A FAST RISE GATE TO START THE MILLER INTEGRATOR V9. RUN-UP ACTION IS STARTED BY THE GATING PULSE FROM V10B. TIMING CONSTANTS ARE R124B, R203-R207 AND C115A-F. D108 AND D109 RETURN THE TIMING CAPACITOR TO THE PROPER QUIESCENT OPERATING LEVEL AFTER RUN-UP.

V8B FURNISHES THE NECESSARY PLATE TO GRID FEED BACK FOR THE INTEGRATOR AND IS ALSO THE CATHODE FOLLOWER TAKE OFF TO THE OUTPUT AMPLIFIER.

RAMP LENGTH (R211) DETERMINES THE NECESSARY VOLTAGE LEVEL TO RESET GATING MULTI V10 WHICH IN TURN STOPS THE RUN-UP AND TERMINATES THE RAMP.

2-36 MAIN OUTPUT

V11B IS A CONVENTIONAL CATHODE FOLLOWER. THE PROPER WAVEFORM BEING FED TO THE GRID IS SELECTED BY THE OUTPUT SWITCH, SW104. THE DC LEVEL OF THE CONTROL GRID IS DETERMINED BY:

A) R216, R217 IF ±DC OUTPUT LEVEL SWITCH IS CCW IN SWITCHED POSITION.

B) R214 IF ±DC OUTPUT LEVEL SWITCH IS CW FROM SWITCHED POSITION.

2-37 EXTERNAL TRIGGER

V3 IS A BI-STABLE MULTIVIBRATOR WHOSE OUTPUTS ARE USED TO:

A) CLAMP THE TRIANGLE GENERATOR GRID (PIN #2, V4A) NEAR GROUND LEVEL WHICH STOPS OPERATION OF THE GENERATING CIRCUITS V1, V2, V4 AND V5.

B) PROVIDE A TRIGGER OUT PULSE AND A GATE TO V10A IN EXT TRIGGER OPERATION.

WHEN THE TRIGGER SWITCH IS IN EXT POSITION, THE FIRST NEGATIVE GOING PORTION OF THE SQUARE AT PIN #7 OF V3 WILL TURN OFF THAT SIDE OF THE TUBE. THIS WILL STOP ALL INTERNAL TRIGGERING DUE TO THE CLAMP ACTION AT GRID PIN #2 OF V4A. THE NEGATIVE GOING PORTION OF AN EXTERNAL OR MANUAL TRIGGER AT PIN #2 OF V3A WILL CAUSE THAT HALF OF THE TUBE TO CUT OFF -- V3B WILL CONDUCT AND THE CLAMP WILL BE REMOVED. OPERATION WILL CONTINUE FOR ONE CYCLE UNTIL THE FALLING EDGE OF THE SQUARE WAVE AGAIN "LOCKS OUT" V3.

SECTION III CALIBRATION PROCEDURE

The following pieces of test equipment are recommended to give the Type 250 FUNCTION GENERATOR a complete calibration.

1. 20,000 ohm/volt voltmeter
2. 100KC bandpass oscilloscope with DC coupled input and external triggering capabilities
3. Variable line voltage input device such as a VARIAC.
4. Distortion analyzer or waveform analyzer such as Donner or Hewlett Packard manufacture.

3-1 POWER SUPPLY

TYPE 250

Strap between chassis gnd & circuit gnd
TRIGGER SOURCE -- EXT

3-11 MEASURE SUPPLY RESISTANCES TO GROUND

-210 volt -- approx. 5.5Kohms
+100 volt -- approx. 19Kohms
+250 volt -- approx. 60Kohms

TYPE 250

Plug AC input into VARIAC set to 117V
Power switch -- ON
TRIGGER SOURCE -- EXT

3-12 CHECK VOLTAGES

-210 volts -- adjust R23
+100 volts -- 5%
+250 volts -- 5%
- 12 volts (reg. filaments) -- 10%

TEST SCOPE

Vertical sens -- most sens position
Input coupling -- AC
Timing -- 10msec/cm
Trigger -- continuously running

3-13 CHECK RIPPLE AND REGULATION

Put test scope input lead on each of the power supplies while varying the line voltage from 105V to 125V. Ripple should be no greater than listed below throughout the input voltage range:

-210 volts -- 10mv
+100 volts -- 10mv
+250 volts -- 10mv
- 12 volts -- 500mv

3-2 TRIANGLE, SQUARE & TIMING

TYPE 250

TRIGGER SOURCE -- INTERNAL
RANGE switch -- 100
Check VAR for mech center & set to 10
OUTPUT ATTEN -- full CW

TEST SCOPE

TRIGGERING -- INTERNAL
SWEEP TIME -- 1msec/cm
VERTICAL SENS -- 50V/cm
INPUT coupling -- DC

3-21 TRIANGLE BALANCE

Put scope probe on pin #8 of V4B and adjust BOTTOM TRIANGLE and TOP TRIANGLE R166 and R157 through range until stable triangles appear on scope.

Adjust BOTTOM TRIANGLE, R166, towards most negative DC level; observe point where triangles disappear and then set adjustment at a stable point more positive.

Adjust TOP TRIANGLE, R157, towards most positive DC level; observe point where triangles disappear and then set adjustment at a stable point more negative.

Rough check the linearity at pin #8 of V5 and readjust slightly if necessary. (Recheck after timing is completed.)

INSTRUMENT SHOULD HAVE BEEN ON AT LEAST 15 MINUTES BEFORE ANY OF THE FOLLOWING ADJUSTMENTS ARE MADE:

3-22 TIMING (PRELIMINARY)

Put scope probe on pin #8 of V4 and check for 10 triangles for 10cm on scope. Time by compensating for half the error with R166 and half with R157.

TYPE 250
TRIGGER SOURCE -- INTERNAL
RANGE switch -- 100
VARIABLE -- 10

TEST SCOPE
TRIGGERING -- INTERNAL
SWEEP TIME -- 100 usec/cm
VERTICAL SENS -- 10V/cm
INPUT coupling -- AC

3-23 SQUARE WAVE SYMMETRY

Connect test scope to SQUARE output of Type 250 and adjust scope triggering so that a change between plus and minus INTERNAL will cause a stationary polarity reversal of one cycle of the square wave.

Position the rise or fall to the center of the graticule and turn the scope magnifier ON. While switching the scope trigger between plus and minus INTERNAL triggering adjust SQUARE W. SYMMETRY (X10) R122 for no shift (equal positive and negative portions).

TYPE 250
Change VARIABLE to 1

TEST SCOPE
Change SWEEP TIME to 1msec/cm

Repeat the preceding calibration adjusting SQUARE W. SYMMETRY (X1) R151.

These two adjustments interact, so careful checking back and forth is necessary if either is adjusted more than a small amount.

TYPE 250
TRIGGER SOURCE -- INTERNAL
RANGE SWITCH -- 100
VARIABLE -- 10

TEST SCOPE

TRIGGERING -- EXTERNAL from SQUARE out
SWEEP TIME -- 1msec/cm
VERTICAL SENS -- 10V/cm
INPUT coupling -- AC

3-24 TIMING (FINAL)

With test scope on TRIANGLE OUTPUT and triggering scope from SQUARE output of Type 250 slightly readjust TOP TRIANGLE and BOTTOM TRIANGLE R157 and R166 for 10 triangles in 10cm.

TYPE 250

Change VARIABLE to 1

TEST SCOPE

Change SWEEP TIME to 10msec/cm

Observe amount of error at this end of dial. Loosen set screw on dial knob and mechanically shift to compensate for error. DO NOT tighten screw until X10 end of dial has been rechecked.

TYPE 250

Change VARIABLE to 10
Change RANGE to 1000

TEST SCOPE

Change SWEEP TIME to 100usec/cm

Adjust timing capacitor C102A for 10 cycles in 10cm

Check timing on all but the slowest two ranges by observing 10 cycles for 10cm.

TYPE 250

Change RANGE to .01

TEST SCOPE

SWEEP TIMING to 1sec/cm

Check timing by observing one cycle for 10cm

TYPE 250
Change RANGE to 10

TEST SCOPE
SWEEP TIME (decade) -- 1msec/cm
Calibrate the SWEEP TIME MULTIPLIER or VERNIER so that it gives a sweep 10 times slower than the decade step indicated on the scope.

TYPE 250
Change RANGE to .001

TEST SCOPE
Change SWEEP TIME (decade) to 1sec/cm
10sec/cm with vernier

Check for one cycle per 10cm
(Have patience!)

TYPE 250
TRIGGER SOURCE -- INTERNAL
RANGE -- 100
VARIABLE -- 10
OUTPUT ATTEN -- full CW

TEST SCOPE
TRIGGERING -- EXT from SQUARE out
SWEEP TIME -- 1msec/cm
VERTICAL SENS -- approx 10V/cm
INPUT coupling -- DC

3-25 TRIANGLE LEVEL & SQUARE WAVE AMPLITUDE

With test scope on SQUARE output adjust the vertical positioning and vertical gain of the test scope to present exactly 4cm of square wave with DC ground at the center (plus and minus 2cm of signal around ground).

With test scope monitoring TRIANGLE output and without touching any scope controls, adjust TRIANGLE DC level, R185, until the center DC level of the triangle wave matches the center DC level of the square wave.

Observe the amplitude of the triangle

With test scope monitoring SQUARE output, adjust SQUARE WAVE AMPLITUDE, R128, until the square wave is the same amplitude as the triangle.

3-3 TRIGGERING (LOCKOUT)

TYPE 250

TRIGGER SOURCE -- INTERNAL
RANGE -- 100
VARIABLE -- 10
OUTPUT ATTEN -- full CW

TEST SCOPE

TRIGGERING -- EXT from SQUARE out
SWEEP TIME -- 1msec/cm
VERTICAL SENS -- 10V/cm
INPUT coupling -- DC

With test scope on TRIANGLE output center the triangle waveform on the scope (DC ground -- center graticule = waveform center)

TYPE 250

Change TRIGGER SOURCE to EXTERNAL

TEST SCOPE

Change sweep to free run

With test scope on TRIANGLE output observe the DC shift of the trace as the VARIABLE dial on the 250 is rotated from 10 to 1. Adjust HOLDOFF DC LEVEL, R136, so that the shift is balanced about the center of the graticule.

TEST SCOPE

Change TRIGGERING to EXT

Connect the TRIGGER OUT of the Type 250 to the EXTERNAL trigger input of the scope. Apply a 10V signal from the scope calibrator to the EXT input of the Type 250. Adjust the test scope for triggered operation and check for proper triggering and output waveform from the Type 250. Remove the calibrator signal from the Type 250 and press the MANUAL button. You should observe one cycle of the waveform each time you press the button.

3-4 TRIANGLE LINEARITY

In this check it is very important to use a scope whose CRT geometry and linearity are calibrated to 1/2% or better. (Check scope linearity by looking at scope's SAWTOOTH OUT.)

TYPE 250

TRIGGER SOURCE -- INTERNAL
RANGE -- 100
VARIABLE -- 10
OUTPUT ATTEN -- full CW

TEST SCOPE

TRIGGERING -- +INTERNAL
SWEEP TIME -- 50usec/cm
VERTICAL SENS -- approx 10V/cm
INPUT coupling -- DC

With the test scope on TRIANGLE output set the scope vertical gain and sweep vernier to just display the rising half cycle of the triangle over the entire graticule area. Observe linearity.

TEST SCOPE

Change TRIGGERING to - INTERNAL

Observe linearity with just the falling half cycle of the triangle occupying the full graticule area of the test scope.

TYPE 250

Change VARIABLE to 1

TEST SCOPE

Change SWEEP TIME to 500usec/cm

Repeat the preceding check at the X1 end of the 250 VARIABLE dial.

If the nonlinearity is approaching 1%, try changing V4 and V5 and go through calibration steps 3-21, 22, 23 & 24

Almost all the adjustments up to this point affect the shape of the sine wave. The pureness of the sine wave will depend on the accuracy of your previous calibration. Any subsequent changes or recalibration of previous steps will make it necessary for you to recheck the calibration of the sine wave.

3-5 SINE WAVE CALIBRATION (see photo 3-52)

Adjustment of the sine wave, if it is quite far out of tolerance, is as much an art as it is a science and you are asked to exercise tolerance and patience. (Checking with the photos of poorly adjusted sine waves will keep you from going too far astray.)

TYPE 250

TRIGGER SOURCE -- INTERNAL
RANGE -- 100
VARIABLE -- 10
OUTPUT ATTEN -- full CW

TEST SCOPE

TRIGGERING -- EXT from TRIGGER OUT
SWEEP TIME -- 200 to 500 usec/cm
VERTICAL SENS -- approx 10V/cm
INPUT coupling -- AC

3-51 PRELIMINARY SETTINGS

With the test scope on the SINE output, adjust the scope triggering for stable EXT triggering from the TRIGGER OUT of the Type 250.

Adjust C SINE SHAPE, R175 CCW to ground.

Adjust A SINE SHAPE, R171 and B SINE SHAPE, R172 for the best looking sine possible. These adjustments are very interdependent and one can be at a setting where it is impossible for the other to correct. B SINE SHAPE controls more of the amplitude and A SINE SHAPE more of the shape itself. It is best to set B for nearly maximum amplitude, then as A is adjusted B can be reduced in amplitude to maintain proper shape. This is an optimum wave shape at this point.

Now adjust C SINE SHAPE, R175, to round the bottom of the sine. A and B can be readjusted for final smoothing.

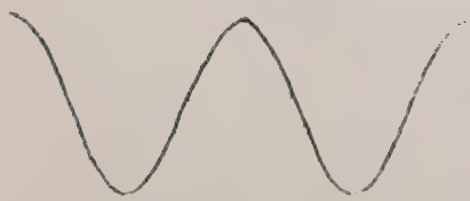
3-52

SINE ADJ B ABOUT CORRECT BUT SINE ADJ A TOO FAR CW. ROTATE "A" CCW UNTIL BOTTOM IS LESS FLAT AND TOP MORE FULL AND ROUND.

SINE ADJ B TOO FAR CCW. ROTATE CW UNTIL TOP IS PROPER SHAPE. IF BOTH TOP AND BOTTOM ARE FLAT, REDUCE AMPLITUDE WITH SINE ADJ B (CW ROTATION) AND ADJUST "A" TO RE-CENTER WAVEFORM (SYMMETRICAL SHAPE).

NOT ENOUGH ADJUSTMENT OF EITHER "A" OR "B". INCREASE AMPLITUDE (CW) WITH SINE ADJ B AND ADJUST "A" CW TO RE-CENTER WAVEFORM.

APPROXIMATELY OPTIMUM SETTING OF "A" AND "B" AND NOW AN ADJUSTMENT OF SINE ADJ C WILL ROUND THE BOTTOM OF THE WAVEFORM PROPERLY.



SINE ADJ C MADE PROPERLY. OPTIMUM SINE WAVEFORM.

IT WILL PAY TO THINK OF THE "B" ADJUSTMENT AS ADDING SIGNAL TO THE SHAPING CIRCUIT; CCW ROTATION CAUSING FLATTENING, CW ROTATION CAUSING TRIANGULAR SHAPE. "A" ADJUSTMENT CONTROLS DC LEVEL AND RE-CENTERS THE WAVE. "C" ADJUSTMENT SERVES TO SHAPE ONLY THE BOTTOM OF THE WAVEFORM.

3-53 FINAL ADJUSTMENT

Connect the SINE output of the Type 250 to a distortion analyzer or waveform analyzer. If you use a waveform analyzer the first 10 harmonics should be checked with adjustments made considering the first five.

Carefully adjust SINE SHAPE A, B & C for minimum harmonic distortion. You should be able to reduce the total to a maximum of 1%. Changing V7 and repeating calibration step 3-51 should be tried if you cannot make specifications.

TYPE 250
Change VARIABLE to 1

Check the distortion at this end of the dial for no more than 2%.

TYPE 250
Change VARIABLE to 10
Change RANGE to 1000

Check distortion at 10kc for no more than 2%.

TYPE 250

TRIGGER SOURCE -- INTERNAL
RANGE -- 100
VARIABLE -- 10
OUTPUT ATTEN -- full CW

TEST SCOPE

TRIGGERING -- EXT from TRIGGER OUT
SWEEP TIME -- 1msec/cm
VERTICAL SENS - approx 10V/cm
INPUT coupling -- DC

3-54 SINE DC LEVEL

Set the test scope trace for center graticule DC 0 volts (ground). Connect the test scope to the SINE output of the Type 250 and adjust SINE DC LEVEL (R182) until waveform is exactly centered on scope CRT.

3-6 RAMP CALIBRATION

TYPE 250

TRIGGER SOURCE -- INTERNAL
RANGE -- 100
VARIABLE -- 10
OUTPUT ATTEN -- full CW

TEST SCOPE

TRIGGERING -- EXT from TRIGGER OUT
SWEEP TIME -- 1msec/cm
VERTICAL SENS -- approx 10V/cm
INPUT coupling -- DC

With the test scope on the RAMP output, rough adjust RAMP LENGTH (R211) and RAMP DC LEVEL (R223) for a stable pattern DC balanced around ground. Fine adjust RAMP LENGTH (R211) for the same amplitude output as the other three waveforms.

Fine adjust RAMP DC LEVEL (R223) for center DC ground.

There should be a "hold-off" time of about 10% at the end of each ramp. This is normal and it is there to allow the ramp to fall and re-establish DC level before rising again, and to assure positive sync to the square wave generator.

TYPE 250
Change RANGE to 1000

TEST SCOPE
Change SWEEP TIME to 100usec/cm

Adjust timing capacitor (C115A) for 10 cycles in 10cm. (Note start of ramp and readjust if not linear.)

TYPE 250
Change VARIABLE to X1

TEST SCOPE
Change SWEEP TIME to 1msec/cm

Observe ramp amplitude and "hold-off" time (should be no more than 20% of total period).

TYPE 250
Change VARIABLE to 10
Change RANGE to 10
Change TRIGGER SOURCE to EXT

TEST SCOPE
Change SWEEP TIME to 10msec/cm

Press MANUAL trigger and check proper operation.

3-7 MAIN OUTPUT

TYPE 250
TRIGGER SOURCE -- INTERNAL
RANGE -- 100
VARIABLE -- 10
MAIN OUTPUT -- SQUARE
OUTPUT ATTEN -- full CW
±DC level -- switched CCW to 0

TEST SCOPE
VERTICAL SENS -- 10V/cm
INPUT coupling -- DC
TIMING -- 1msec/cm
TRIGGER -- EXT from TRIGGER OUT

3-71 OUTPUT ATTEN.

With the test scope on MAIN OUTPUT, check for approx. 30 volt peak to peak signal (min. of 27 volts). Rotate the ATTEN. knob full CCW. Amplitude should decrease to approx. 5 volts (must go below 10V).

TEST SCOPE
Change VERTICAL SENS to 20V/cm

3-72 ±DC LEVEL

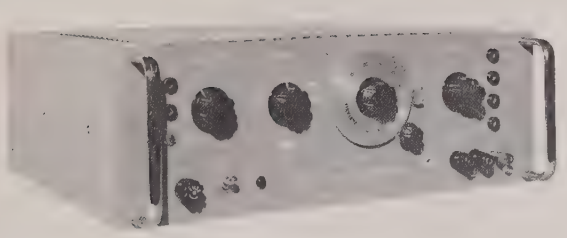
Turn ATTEN on Type 250 back full CW and center trace on scope screen. Turn ±DC LEVEL adjustment CW out of switched position and check range of adjustment for full below ground through above ground operation.

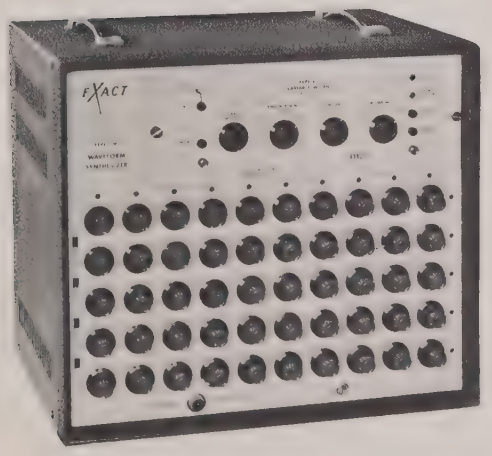
3-73 FUNCTION COMPARISON

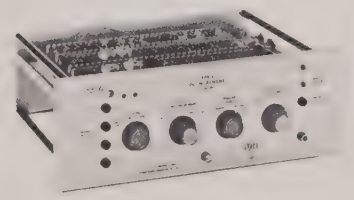
Check all waveforms at MAIN OUTPUT for amplitude and DC level comparison within ±3%. (Sine wave may be as much as 5% lower.)

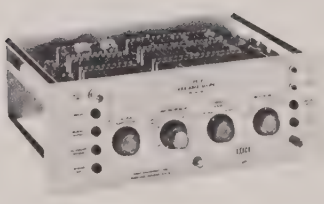
FUNCTION - SQUARE WAVE - PULSE CODE - CALIBRATION

GENERATORS









SWEEP GENERATION

COMPUTER PROGRAMMING

STAIRSTEP GENERATION

FORCING FUNCTION GENERATION

SCOPE AND METER CALIBRATION

VIBRATION AND SHOCK GENERATION

SUBTRACTION OF ERROR SIGNAL AND NOISE

MEDICAL SIMULATION AND STIMULATION

PCM - PAM - PWM - FMFM SIMULATION

GENERAL WAVEFORM SYNTHESIS

TEST QC AND CALIBRATION

DISTORTION ANALYSIS

SERVO PROGRAMMING

EXACT

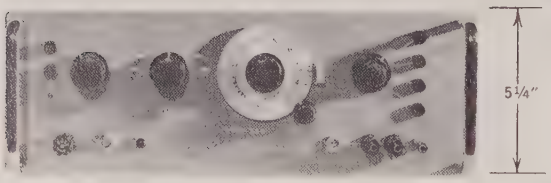
EXACT ELECTRONICS, INC.

455 So. 2nd Street • P.O. Box 160

Hillsboro, Oregon

PHONE: MIdway 8-3590 AREA CODE: 503

TYPE 250 FUNCTION GENERATOR

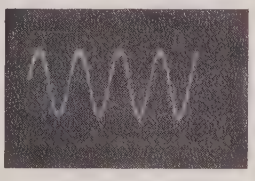


Multiple Waveform Source

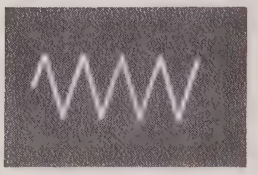
Analog Computer Programming
Geophysical Simulation
Mechanical Studies
Medical Stimulation
QC and Calibration
Sweep Generation

SQUARE

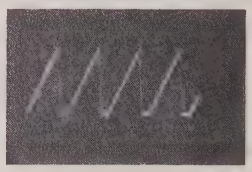
SINE



TRIANGLE



RAMP



SIMULTANEOUS USE OF ANY OR ALL FOUR WAVEFORMS

0.001 to 10 KC RANGE, continuously variable.

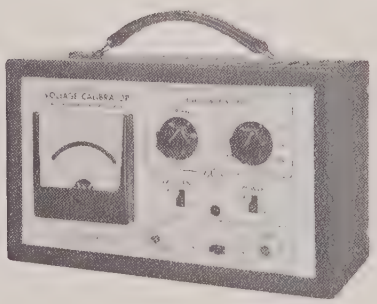
EXTERNAL TRIGGERING, manual triggering, and continuous operation.

VARIABLE REFERENCE LEVEL for above and below-ground wave-forms.

25V at 15MA main output

LESS THAN 2% AMPLITUDE variation.

*A cosine waveform is available in the model 250-C



SCOPE CALIBRATION

METER CALIBRATION

UNKNOWN VOLTAGE COMPARISON

The output from the Type 100 is a IKC positive going square wave or a positive DC level depending on your need. A ½ % meter is connected directly across the output so that any external loading will give you an accurate reading of true output voltage. 0.05% divider resistors are used in the output to provide an overall accuracy of ¾ %. Since the meter is at the output, failure or drift of any component will not affect the true reading of output voltage.

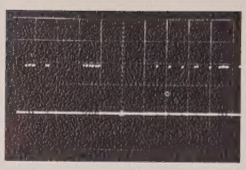
The Type 105 combines the circuitry and operation of the Type 100 with an internal chopper comparator. An input signal from 2mv to 100V (20mv to 600V with a compensated 10x divider) is mixed at a 60-cycle rate with the internal calibrator signal and the resultant output can be observed on a monitor oscilloscope.

TYPE 100 105 VOLTAGE CALIBRATORS

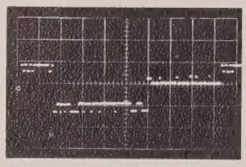
PULSE CODE GENERATORS

THE TYPE 200 WITH TYPE C VARIABLE WIDTH PLUG-IN GENERATES A SEQUENCE OF 50 SEPARATE VOLTAGE LEVELS OR INCREMENTS. THE MAIN FEATURE OF THE "C" UNIT IS THAT EACH OF THESE 50 INCREMENTS IS SEPARATELY ADJUSTABLE IN WIDTH. You may vary two other parameters simultaneously: (1) The individual amplitude of each increment from 0 to 30 volts. (2) The duration of all the increments as a group from 20 usec. to 50 sec. The rise and falltimes of the individual levels are 0.3 usec. Each increment may be manually triggered, externally triggered or triggered at the internal rate. You may also trigger each row of 10 increments or the full program of 20 to 50 increments in the same manner. Output amplitude and DC reference level of the output may be continuously varied to produce 0 to 30 volts at 10 ma between —15 volts and +30 volts.

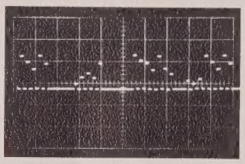
THE TYPE 200 WITH TYPE E 100 INCREMENT PLUG-IN GENERATES A SEQUENCE OF 100 SEPARATE VOLTAGE LEVELS OR INCREMENTS. THE MAIN FEATURE OF THE "E" UNIT IS THE ABILITY TO GENERATE A PROGRAM OF 100 VOLTAGE LEVELS. You may vary two other parameters simultaneously: (1) The individual amplitude of each increment from 0 to 30 volts. (2) The duration of all the increments as a group from 20 usec. to 100 sec. The rise and falltimes of the individual levels are 0.3 usec. Each increment may be manually triggered, externally triggered or triggered at the internal rate. You may also trigger each row of 10 increments or the full program of 20 to 100 increments in the same manner. Output amplitude and DC reference level of the output may be continuously varied to produce 0 to 30 volts at 10 ma between —15 volts and +30 volts.



PCM-PWM TELEMETRY



STAIRSTEP AND CODE TRANSMISSION



PAM

TYPE 200 WAVEFORM SYNTHESIZER AND TYPE A C E F PLUG-IN GENERATORS

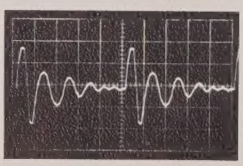
COMPLEX WAVEFORM GENERATORS

THE TYPE 200 WITH TYPE A VARIABLE SLOPE PLUG-IN GENERATES A SEQUENCE OF 50 INDIVIDUALLY ADJUSTABLE SLOPE SEGMENTS. THE MAIN FEATURE OF THE "A" UNIT IS THAT EACH OF THESE 50 INCREMENTS MAY BE INDEPENDENTLY VARIED IN SLOPE AND VOLTAGE LEVEL ALLOWING DISCONTINUOUS WAVEFORMS TO BE GENERATED: The voltage level of each may be varied from 0 to 40 volts and the slope adjusted + and —5 volts pivoting from the center of each increment.

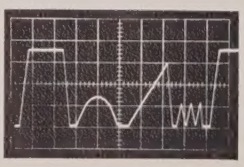
The duration of all the increments as a group may be varied from 33 usec. to 50 sec. External triggering or manual triggering is not available in this unit but a SYNC output is available to trigger other equipment. Output amplitude and DC reference level of the output may be continuously varied to produce 0 to 50 volts at 10 ma between —25 volts and +50 volts. Two simultaneous but separate auxiliary outputs of 50 increments are also available at 10 volts and 5 ma.

THE TYPE 200 WITH TYPE F VARIABLE SLOPE PLUG-IN GENERATES A SEQUENCE OF 50 INDIVIDUALLY ADJUSTED SLOPE SEGMENTS. THE MAIN FEATURES OF THE "F" UNIT ARE THE + AND —25 VOLT RANGE OF EACH SLOPE, THE TOTAL LACK OF DISCONTINUITY BETWEEN SLOPE SEGMENTS AND THE TRIGGERING FLEXIBILITY. The individual slope of each increment may be varied over a 50 volt range and the duration of all the increments as a group may be varied from 33 usec. to 50 sec.

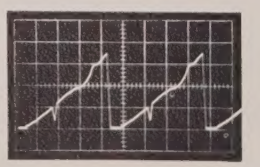
Each increment may be manually triggered, externally triggered or triggered at the internal rate. You may also trigger each row of 10 increments or the full program of 20 to 50 increments in the same manner. Output amplitude and DC reference level of the output may be continuously varied to produce 0 to 50 volts at 10 ma between —25 and +50 volts. Two simultaneous but separate auxiliary outputs of 50 increments are also available at 10 volts and 5 ma.



WAVEFORM ANALYSIS DISTORTION STUDIES



GENERAL RESEARCH ANALOG COMPUTOR SERVO ANALYSIS/TEST



COMPENSATION FOR DISTORTION OR SYSTEM NON-LINEARTY

EXACT

Exact Electronics, Inc., P. O. Box 160, Hillsboro, Oregon MI 8-3590

CAT #11 March 1962 Prices and specifications subject to change without notice